

Development of low-cost flax fibre
preforms for high-performance
composites

FlaxPreComp

NANOFORCE research program

The consortium

Industrial partners (SMEs)

Wavalin cvba	}	Flax fibre production
Vlasbedrijf Verhalle nv		
Vanacker Rubmeke bvba		
Eurofino bvba		
Soeries Elite nv	}	Yarn spinning
Flipts & Dobbels nv	}	Weaving

Research partners

KU Leuven
MTM
CIT – KULAK

UGent
Bioscience Engineering - Woodlab

Outline

Why flax?

From plant to preform

Project results

Conclusion

Flax: a natural and durable material

Why flax?

- ✓ Renewable resource
- ✓ Recyclable (thermal)
- ✓ Biodegradable
- ✓ CO₂ neutral



Drawing of glass fibers [1]



Drying of flax fibers [2]

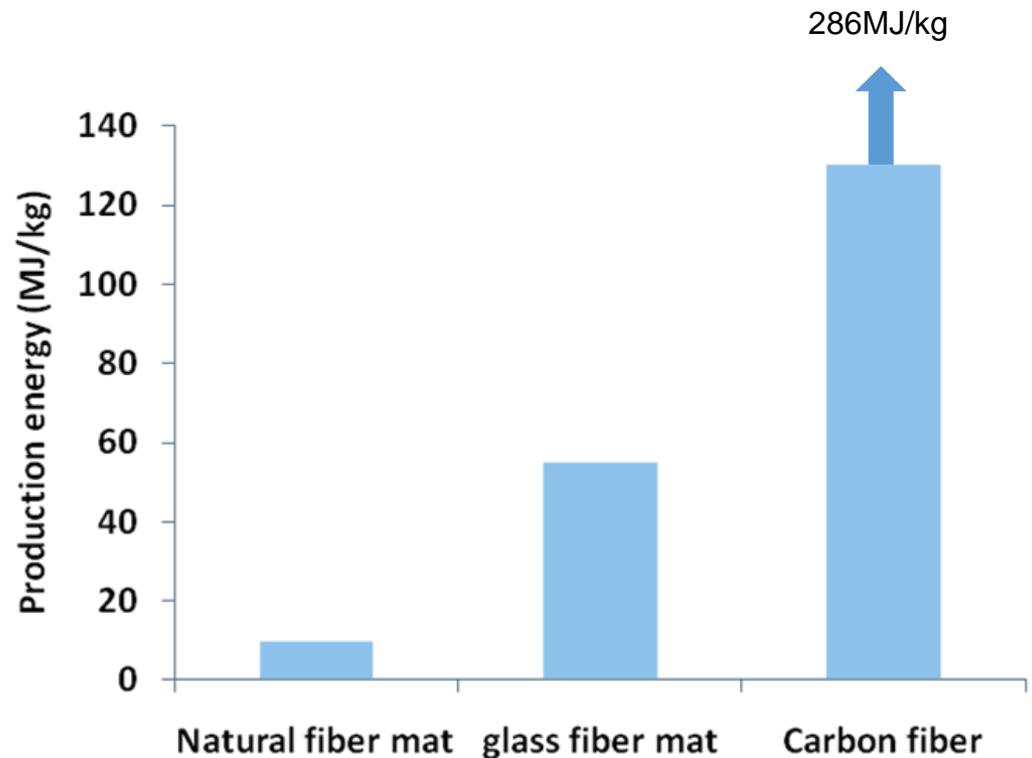
[1] J. Amos, available from <http://photography.nationalgeographic.com>

[2] S.N., available from <http://www.focal.com/img/cms/technical-folders/flax/flax-field.jpg>

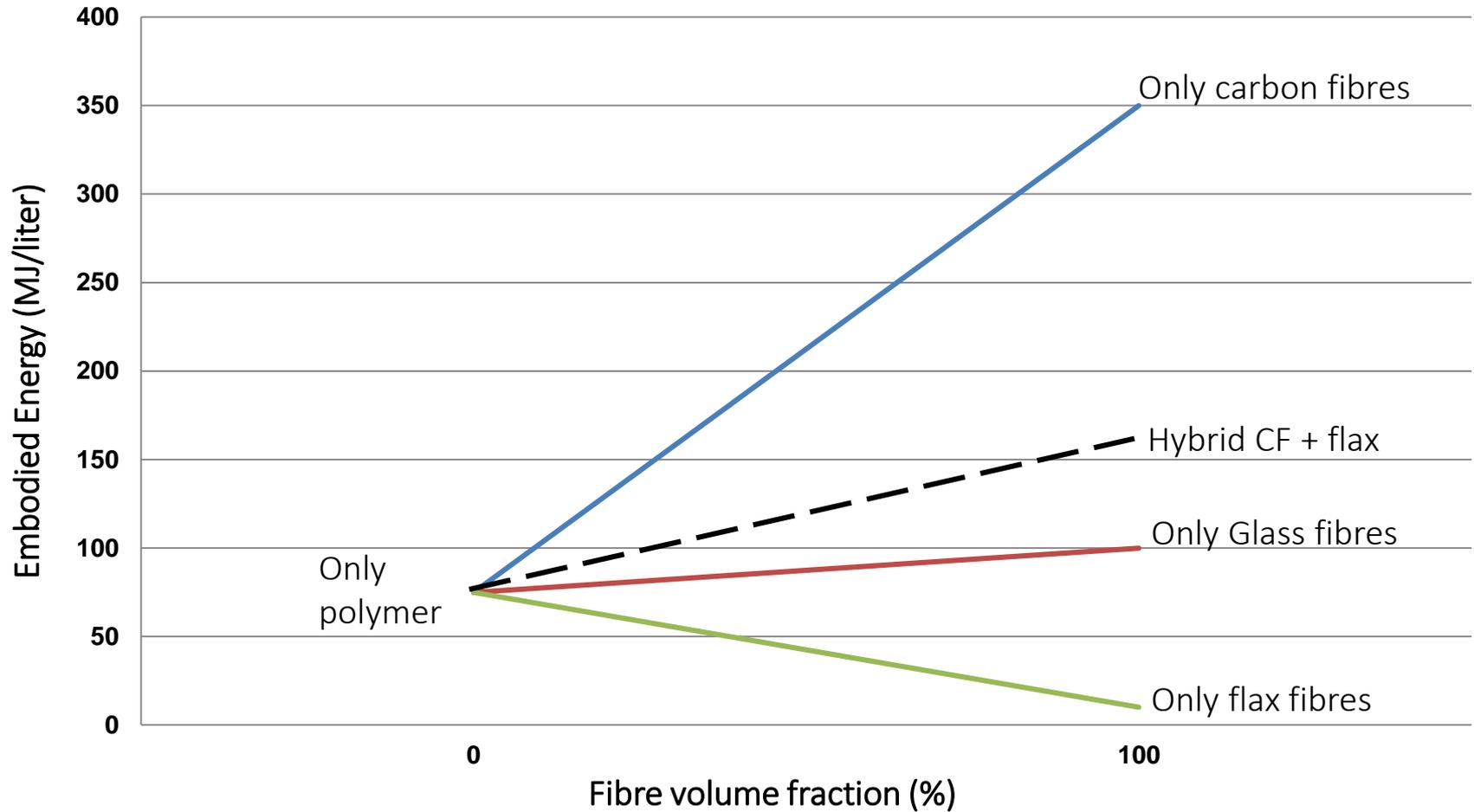
Flax: a natural and durable material

Why flax?

- ✓ Renewable resource
- ✓ Recyclable (thermal)
- ✓ Biodegradable
- ✓ CO₂ neutral
- ✓ **Low embodied energy**



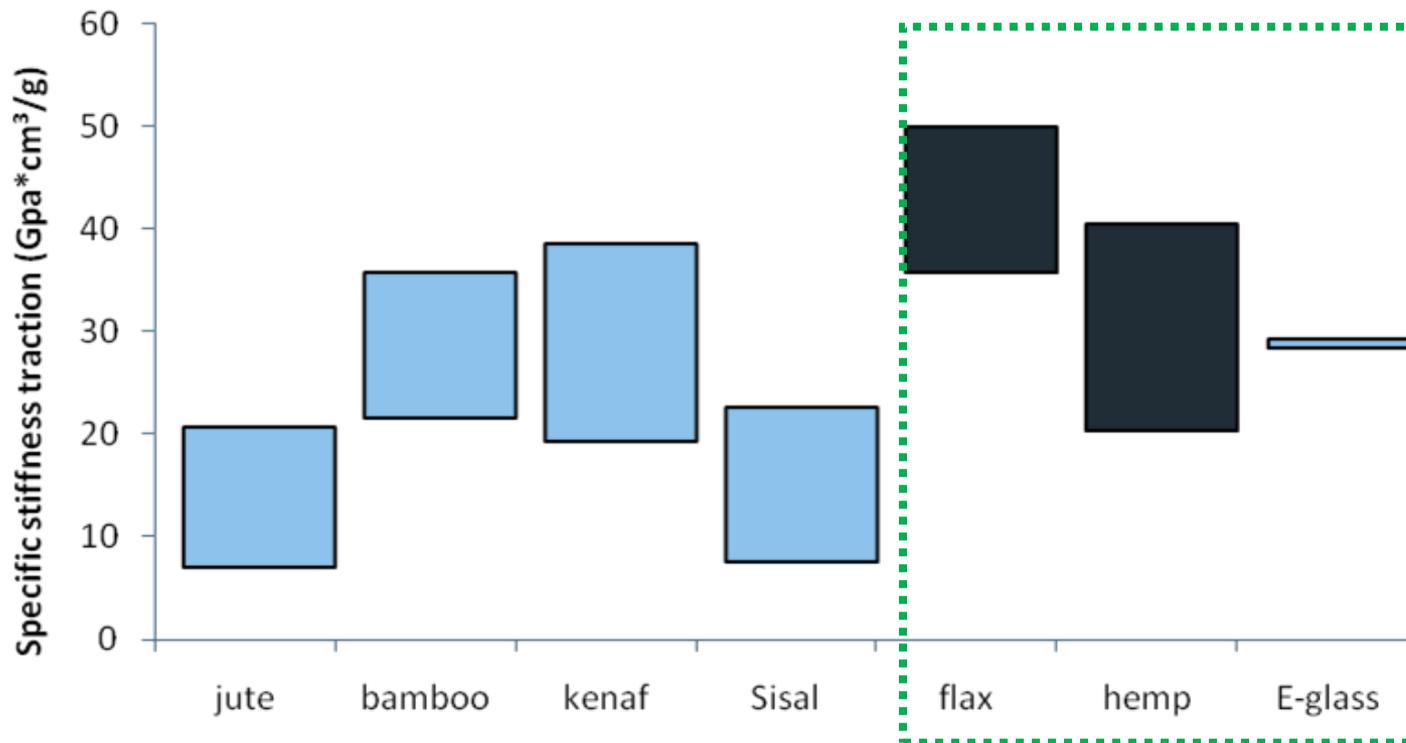
Composites: embodied energy/liter



Flax fibres: light and stiff

Specific stiffness = stiffness / density

- ✓ Key design parameter for **lightweight** constructions
- ✓ Indicates weight benefit → energy reduction during use phase



Outline

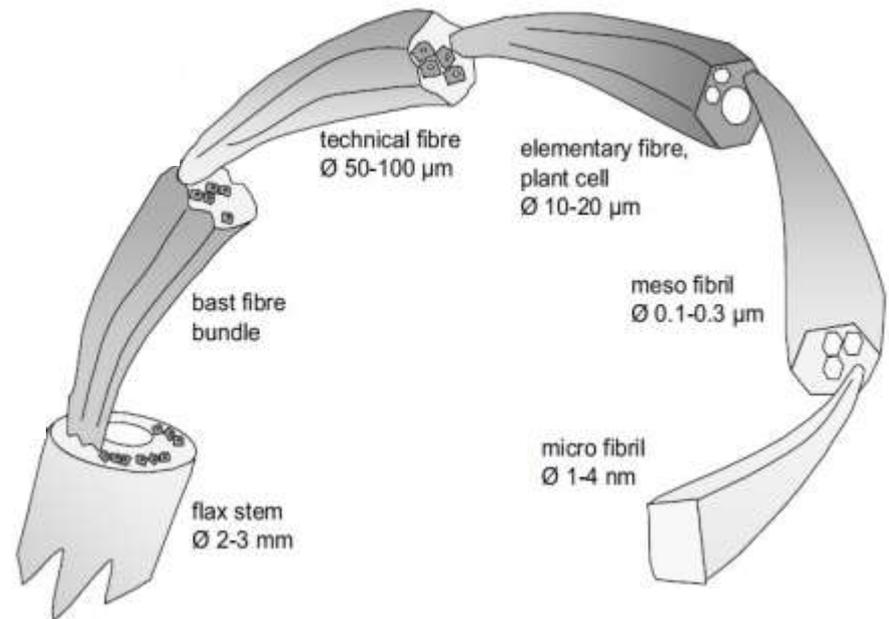
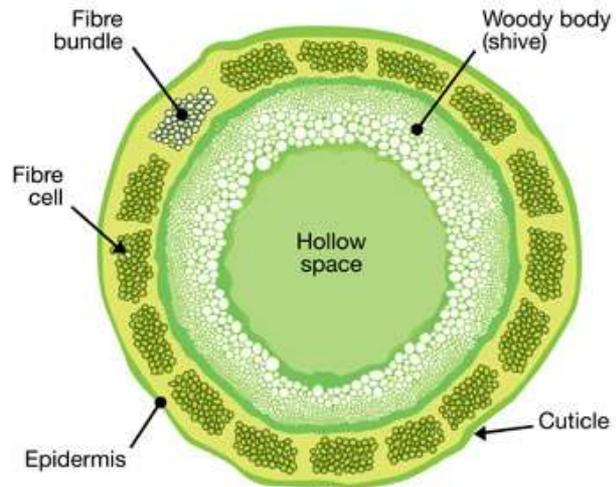
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Location of the fibres in the stem



Extracting flax fibres for non-technical preforms



Retting

Scutching

Hackling

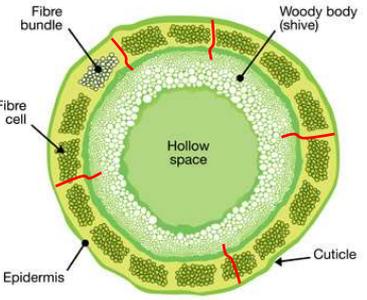
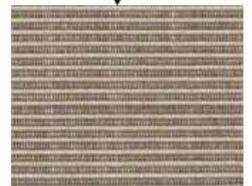
Doubling/stretching

Roving bench

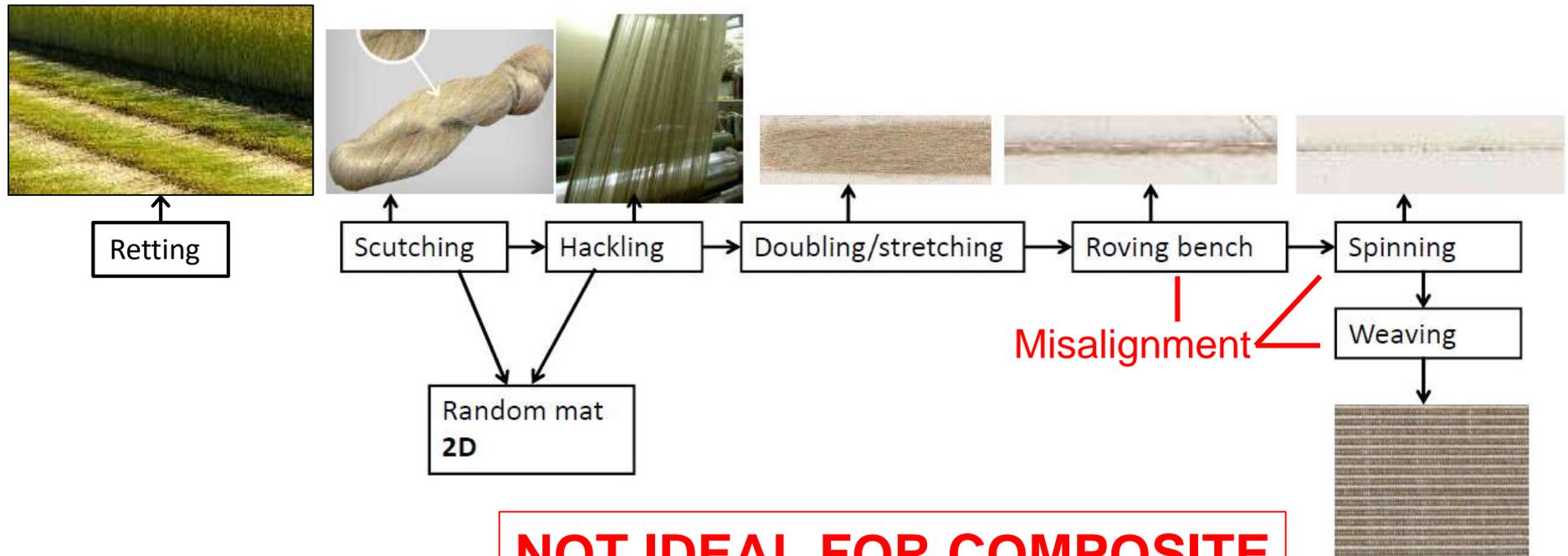
Spinning

Random mat
2D

Weaving



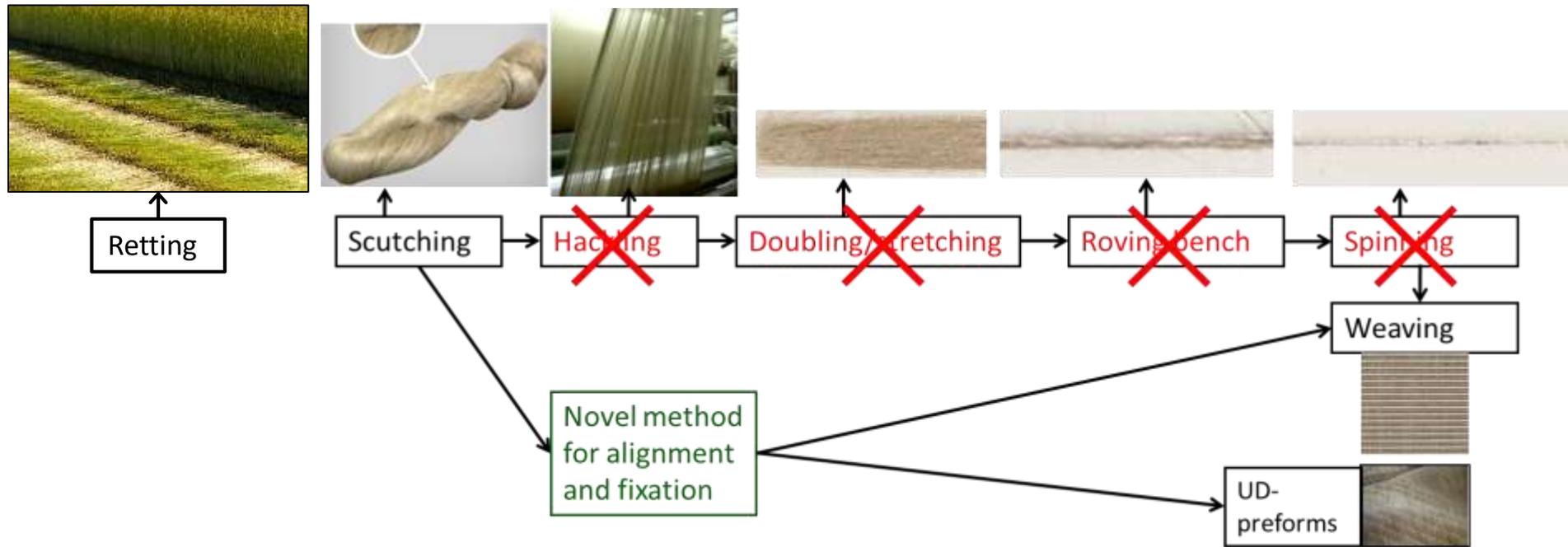
Extracting flax fibres for technical preforms



NOT IDEAL FOR COMPOSITE APPLICATIONS

Increasing cost – fibre damage - misalignment

Extracting flax fibres for technical preforms



Increasing cost – fibre damage - misalignment

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Why flax?

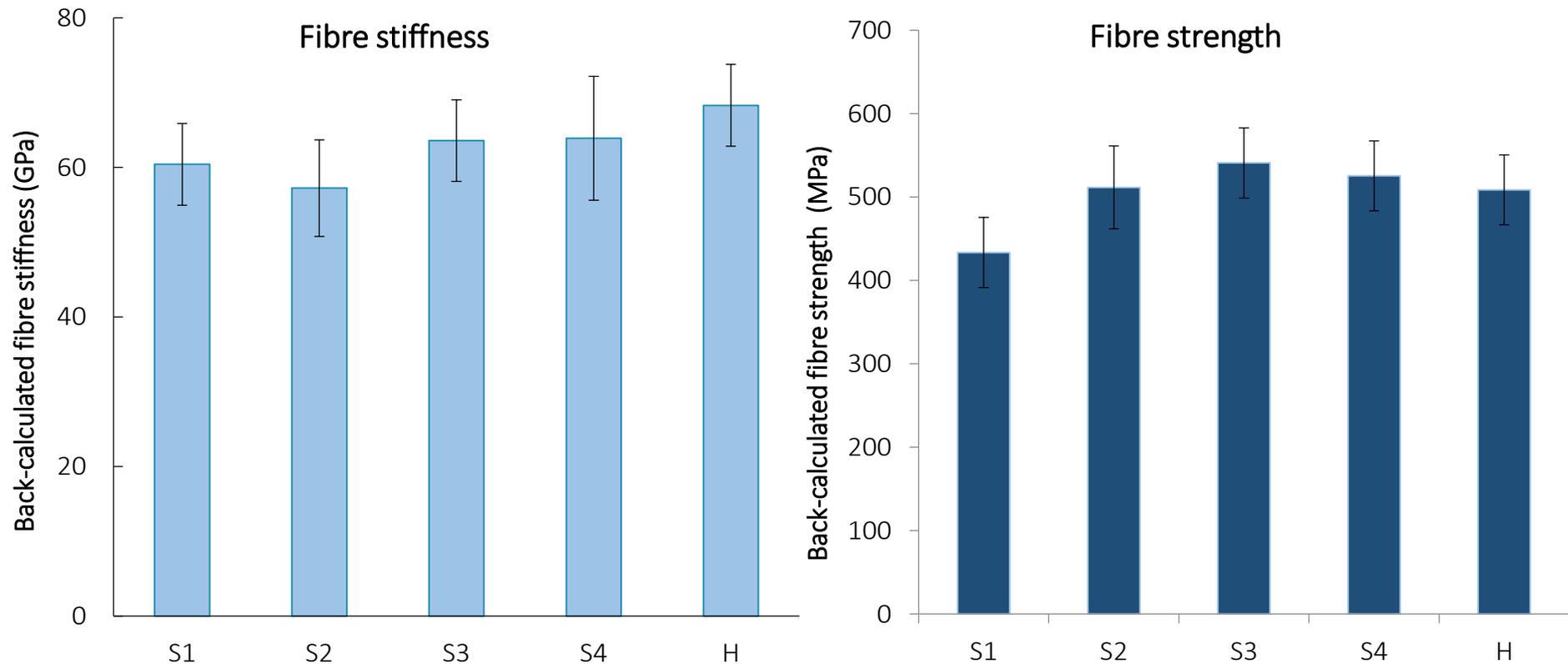
From plant to preform

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Composite performance of scutched fibres

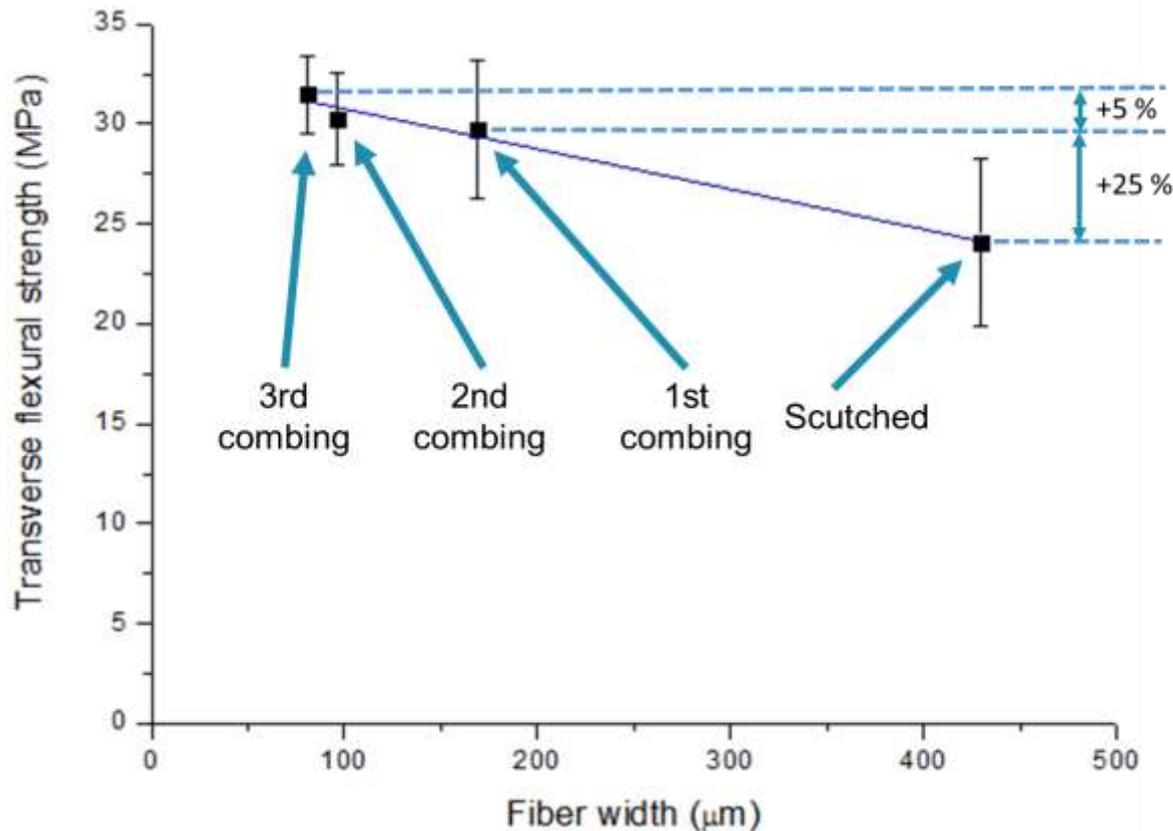
Longitudinal performance of scutched and hackled fibres is nearly identical



Composite performance of scutched fibres

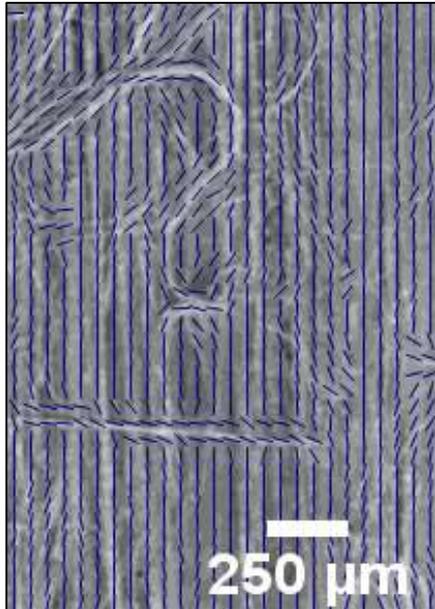
Transverse performance of scutched fibre composites is lower

A mild refinement operation (\neq hackling) increases performance by 25%

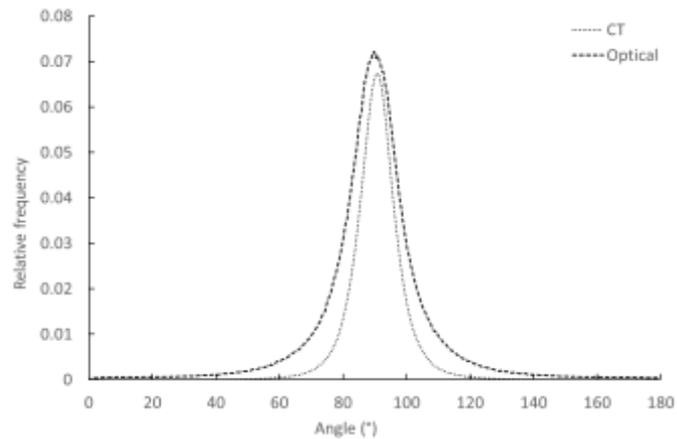
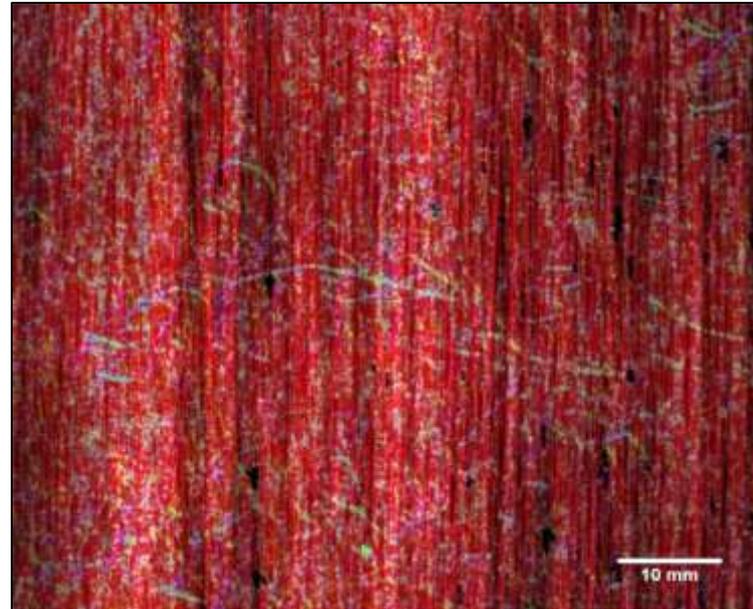


Fibre orientation in UD preforms

Optical
(surface)



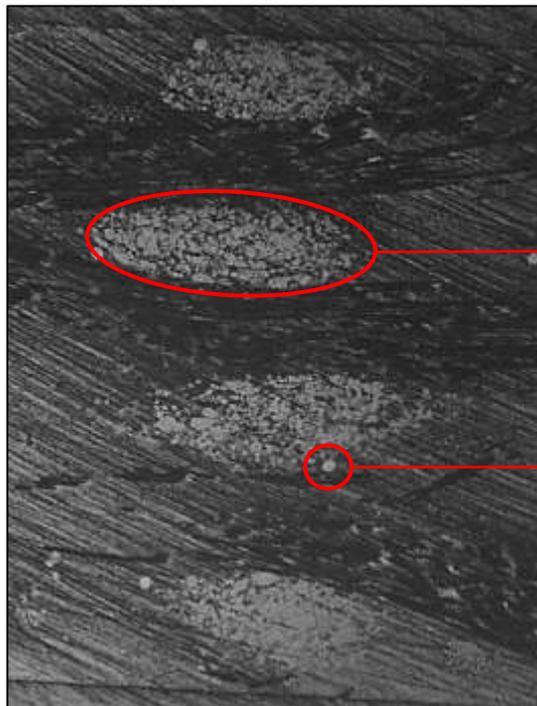
CT
(thickness)



Low-twist yarns and low-crimp weaves

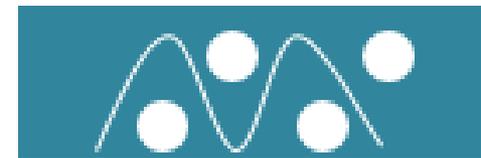
Low-twist yarns → decreased misorientation of the fibres

Lower twist in yarns → **decreased crimp** in weaves



Elliptical yarn shape

Winding filament

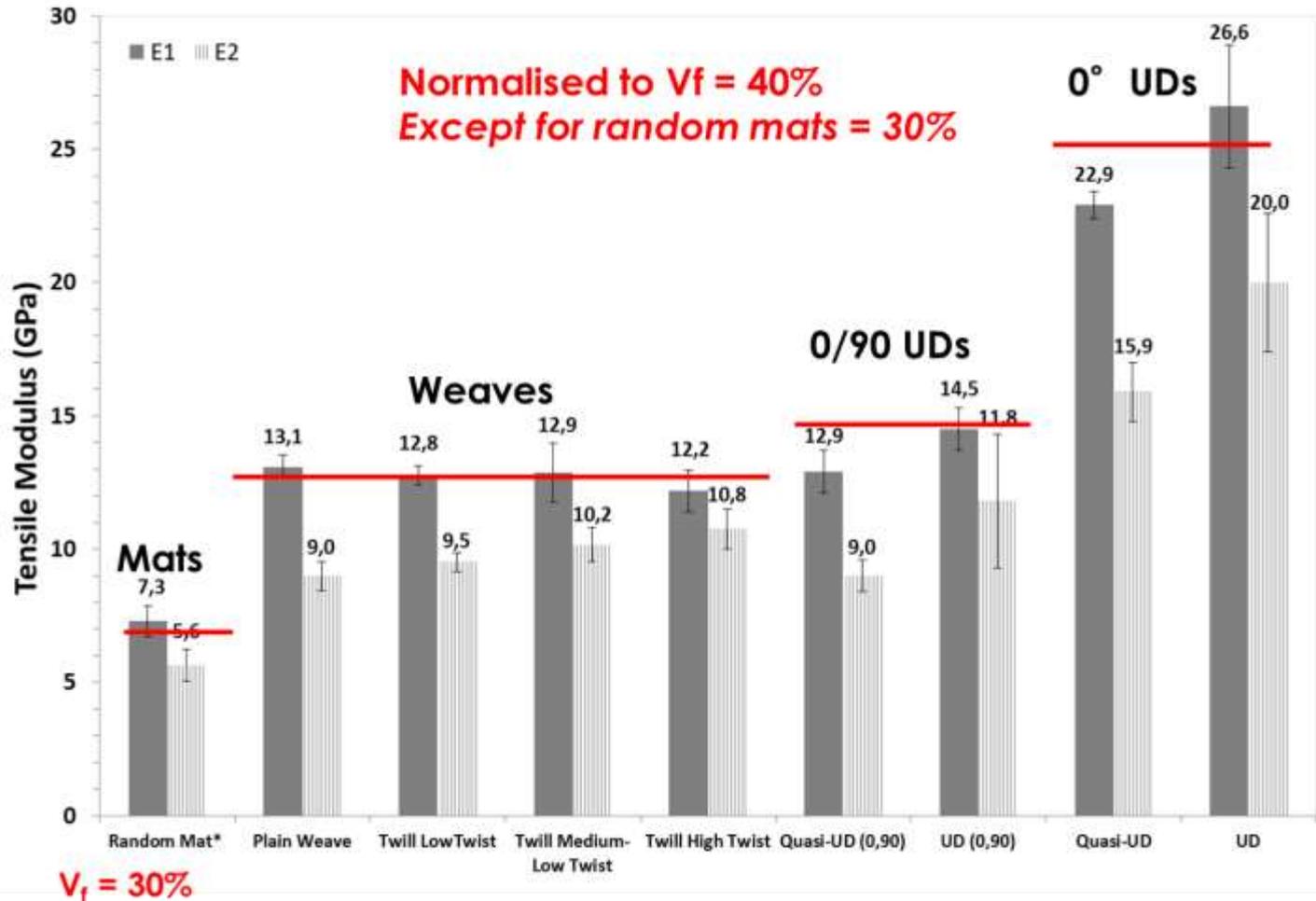


High crimp

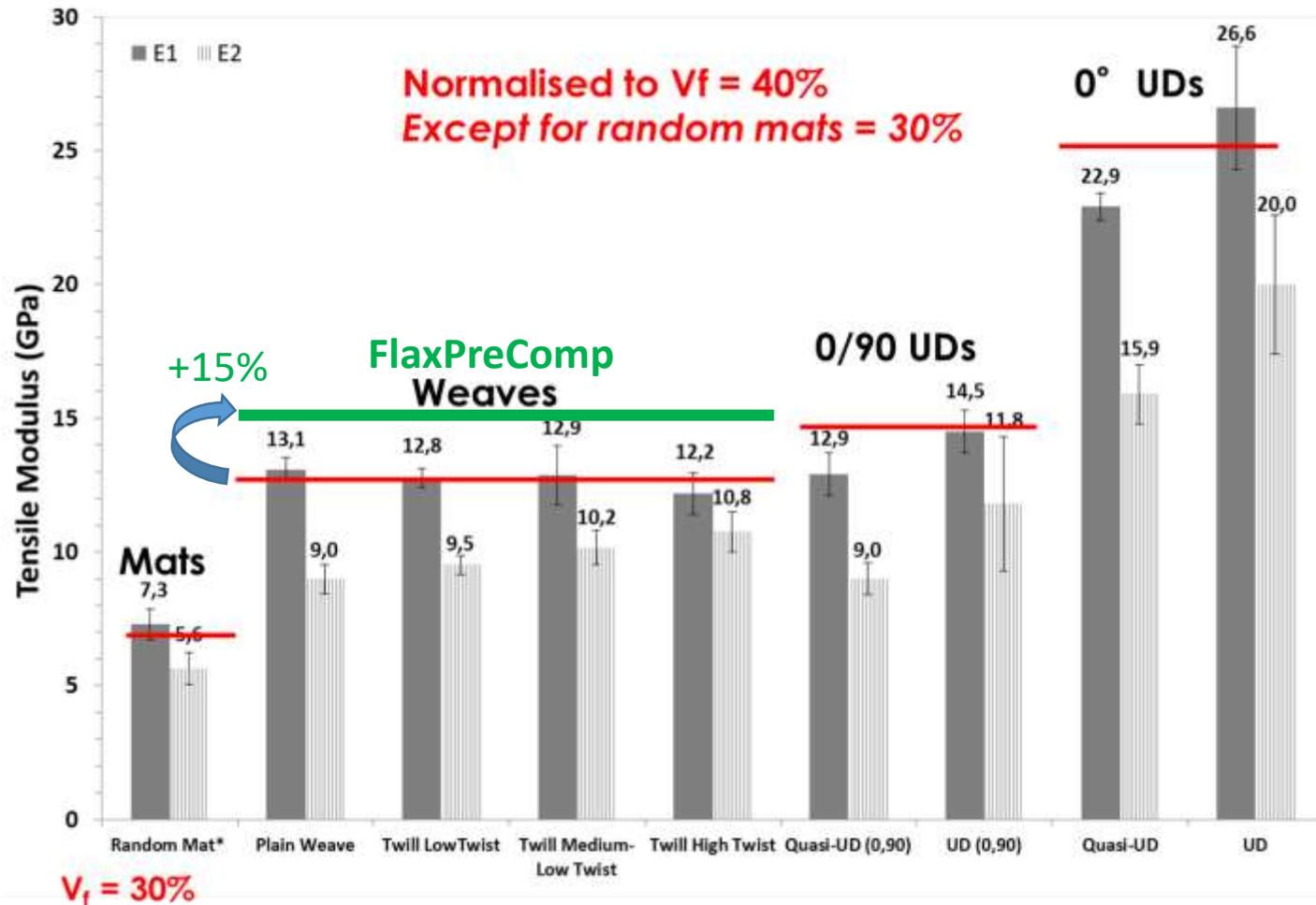


Low crimp

Performance of low-crimp weaves



Performance of low-crimp weaves



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- ✓ Developed a novel alignment and fixation method to produce preforms, starting from scutched flax fibres
- ✓ Performance of scutched fibres matches that of hackled fibres
- ✓ Fibre orientation in the preforms can be monitored through surface scans
- ✓ Low-twist yarns and low-crimp weaves have been produced successfully